PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-068109
(43)Date of publication of application : 07.03.2003

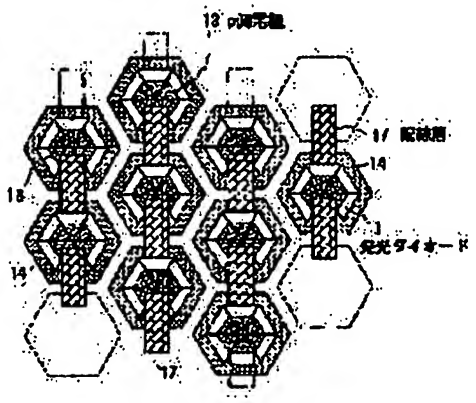
(51)Int.Cl. F21S 8/04
F21S 2/00
F21V 9/08
G02F 1/13357
G09F 9/00
H01L 33/00
// F21Y101:02

(21)Application number : 2001-252401
(22)Date of filing : 23.08.2001

(71)Applicant : SONY CORP
(72)Inventor : NATORI TAKEHISA
MORI YOSHIFUMI

(54) LUMINAIRE AND PROJECTOR

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a luminaire that has a structure in which light emitting devices such as a light emitting diode can be arrayed at high density.
SOLUTION: The luminaire has a structure in which a plurality of pointed light emitting devices are arrayed most densely to form a light emission surface. The densest array in the light emission surface as a light emission part in a surface array can maximize luminance per unit area, and the use of the pointed light emitting devices can permit wiring using empty space about pointed portions to ensure sufficient connection even under the densest array.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The lighting system which is made to carry out the maximum dense array of the light emitting device of the shape of two or more cusp, and is characterized by coming to form a luminescence side.
[Claim 2] The light emitting device of the shape of said cusp is a lighting system according to claim 1 with which only a predetermined number is characterized by carrying out parallel connection of the configuration connected to the serial.
[Claim 3] Said predetermined number is a lighting system according to claim 2 characterized by being a number corresponding to the value which broke rated voltage by forward voltage of the light emitting device concerned.
[Claim 4] The light emitting device of the shape of said cusp is a lighting system according to claim 1 characterized by being arranged on a support substrate.
[Claim 5] The light emitting device of the shape of said cusp is a lighting system according to claim 1 characterized by the acumination part of one component and the bottom surface part of the component of another side being connected by the wiring layer among the components which the acumination part of a component and the bottom surface part of a component are made into the polar zone, respectively, and adjoin between the light emitting devices of the train by which series connection is carried out.
[Claim 6] The light emitting device of the shape of said cusp is a lighting system according to claim 1 characterized by having the structure to which the sloping field was made to carry out the laminating of the 1st conductive layer, a barrier layer, and the 2nd conductive layer.
[Claim 7] The lighting system characterized by making the light emitting device of the shape of two or more cusp arrange, forming a luminescence side, and forming the resistance section in said light emitting device at a serial, respectively.
[Claim 8] Said resistance section is a lighting system according to claim 7 characterized by forming a high resistance wiring layer in the shape of a coil.
[Claim 9] Said high resistance wiring layer is a lighting system according to claim 7 characterized by being formed in the support substrate side of said light emitting device.
[Claim 10] the light emitting device of the shape of two or more cusp — ** — the lighting system characterized by coming to form an optical-pumping fluorescent substance layer in the optical ejection side side while making it arrange densely.
[Claim 11] The luminescence wavelength of said light emitting device and the luminescence wavelength of said optical-pumping fluorescent substance layer are a lighting system according to claim 10 characterized by being different wavelength.
[Claim 12] It is the lighting system according to claim 10 characterized by for said light emitting device being the light emitting diode of blue luminescence, and exciting said optical-pumping fluorescent substance layer by blue glow, and enabling yellow luminescence.

[Claim 13] It is the lighting system according to claim 10 characterized by for said light emitting device being the light emitting diode of purple luminescence, and exciting said optical-pumping fluorescent substance layer with purple light, and enabling white luminescence.
[Claim 14] The lighting system characterized by only the minimum margin distance the light emitting device of the shape of two or more cusp is decided to be on a process being estranged and arranged, and coming to form said luminescence side by the light emitting device of two or more shape of said cusp.
[Claim 15] The lighting system which is made to carry out the maximum dense array of the light emitting device of the shape of two or more cusp, and comes to form a luminescence side, and projection equipment characterized by having the transparency mold image display section arranged in the optical projection way of said lighting system.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the lighting system which is made to arrange densely two or more light emitting devices, such as a semi-conductor light emitting device, and uses the light from this light emitting device for lighting.
[0002]
[Description of the Prior Art] The array structure of making semi-conductor light emitting devices, such as light emitting diode, arranging in the shape of an array is used for various kinds of equipments from before. Such array structure of a semi-conductor light emitting device may be used as the light source for electric discharge of a copying machine (for example, refer to JP,4-137675,A.), or may be used as an LED unit (for example, refer to JP,4-344992,A.) of the image sensors for recognizing an alphabetic character etc.
[0003] as [indicate / as such an example / generate light which reaches direct human being's eye further, aiming at use as a lighting system is also examined, and / although the array structure of these semi-conductors light emitting device is used as a luminescence means within various kinds of copying machines and readers / structure / by JP,9-297549,A] — flexible — a line — the example like an emitter, other illumination material, etc. are coming to be used widely.
[0004]
[Problem(s) to be Solved by the Invention] When two or more semi-conductor light emitting devices like light emitting diode are made to arrange in the shape of an array and it constitutes a lighting system, it is possible to obtain a lighting system with high brightness, making a consistency high comparatively by putting light emitting diode in order with a bare chip.
[0005] However, even if it is the case where put the light emitting diode of two or more field luminescence molds in order, and a lighting system is constituted for example, when the structure of light emitting diode forms a barrier layer in the semi-conductor layer of the planar structure which carries out a laminating to a plane In order to divide and prepare an electrode in a top and the bottom on both sides of a barrier layer, to connect two or more light emitting diodes to a serial and to make light emit The wire and wiring which connect the electrode of a top and the bottom are needed, and

since a wire and wiring pass in the clearance between adjoining bare chips, it becomes difficult to arrange a bare chip in high density.

[0006] Moreover, when two or more semi-conductor light emitting devices like light emitting diode are made to arrange in the shape of an array and it constitutes a lighting system, using a constant current source as an object for the drive currents for driving light emitting diode is often performed. It is constituted so that it may generally drive by the constant current source, since dispersion tends to produce light emitting diode from dispersion on that manufacture in the forward voltage Vf about each light emitting diode and this makes dispersion in each light emitting diode control for this reason.

[0007] However, in the case where much light emitting diodes are connected to juxtaposition, many currents flow to light emitting diode with low forward voltage Vf, and the problem that the problem that the life of the component which the current concentrated will become short occurs, or dispersion in luminescence brightness occurs arises. Although the brightness as the whole is also important for a lighting system, it is also required to suppress dispersion in the brightness in a luminescence side, and it is not easy to obtain ideal lighting.

[0008] One of these is also carried out, and when there is at least one open circuit in two or more light emitting diodes by which series connection is carried out, the whole stops emitting light and it will become impossible moreover, to use as a lighting system, although it will become possible to absorb dispersion in the forward voltage Vf of light emitting diode if much light emitting diodes are connected to a serial. Moreover, when series connection of the light emitting diode is carried out and it constitutes a lighting system, the electrical potential difference of the drive also becomes high, and the problem that the burden of a power unit increases is also generated.

[0009] Then, this invention aims at offer of the lighting system of the structure which can arrange a light emitting device to high density, and projection equipment in view of an above-mentioned technical technical problem. Moreover, this invention sets offer of the lighting system which performs luminescence which it was long lasting, was uniform and was stabilized, and projection equipment as other purposes.

[0010]

[Means for Solving the Problem] In order to solve an above-mentioned technical technical problem, the lighting system of this invention carries out the maximum dense array of the light emitting device of the shape of two or more cusp, and is characterized by coming to form a luminescence side. By carrying out the maximum dense array of the luminescence side which is the light-emitting part arranged in the shape of a field, the brightness per unit area can be made the highest and the connection to the electrode of the both sides by the side of n and p can be prepared in the side in which it exists for an acumination part [a component] by moreover using a cusp-like light emitting device. the side attachment wall over luminescence sides, such as a rectangular parallelepiped and tabular, — a luminescence side — receiving — abbreviation — when using a cusp-like light emitting device compared with the component structure which becomes perpendicular, wiring while using the tooth space as for which the perimeter for an acumination part was vacant is attained, and sufficient connection can be aimed at even if it carries out the maximum dense array.

[0011] Other lighting systems of this invention make the light emitting device of the shape of two or more cusp arrange, form a luminescence side, and are characterized by forming the resistance section in a serial, respectively at said light emitting device. Since brightness can be made high and the resistance section is formed in each light emitting device at a serial, securing good wiring, even when dispersion is in the forward voltage Vf of each light emitting device according to such a lighting system, a problem on which it concentrates on a light emitting device with low forward voltage Vf, and a current flows is eased, and control of the reinforcement of a component or dispersion of brightness is also possible.

[0012] the lighting system of further others of this invention — the light emitting device of the shape of two or more cusp — ** — while making it arrange densely, it is characterized by coming to form an optical-pumping fluorescent substance layer in the optical ejection side side. According to such a lighting system, the wavelength of the light which a light emitting device emits can be made to change and output by being able to make the brightness per unit area the highest, securing good wiring, and arranging an optical-pumping fluorescent substance layer in an optical ejection side side.

[0013] Moreover, the projection equipment of this invention carries out the maximum dense array of

the light emitting device of the shape of two or more cusp, and is characterized by having the transparency mold image display section arranged in the optical projection way of the lighting system which comes to form a luminescence side, and said lighting system. According to this projection equipment, securing good wiring, the brightness per unit area can be made the highest, and the high projection image of brightness can be displayed using the directive height of a light emitting device.

[0014]

[Embodiment of the Invention] Hereafter, the lighting system of this operation gestalt is explained, referring to a drawing. Drawing 1 is the top view expanding and showing some lighting systems of this operation gestalt, and drawing 2 is the fragmentary sectional view of the lighting system of drawing 1 . two or more light emitting diodes 11 in the form stuck in the lighting system of this operation gestalt on the support substrate 10 like a transparent glass substrate or a synthetic-resin substrate — the maximum — it is arranged so that it may become dense. One light emitting diode 11 consists of the crystal sections of an abbreviation hexagon-head drill configuration, and the part of an abbreviation hexagon-head drill configuration has the tapering acumination part 12. The light emitting diode 11 which has the crystal section of such an abbreviation hexagon-head drill configuration If the compound semiconductor layer of a GaN system can constitute and an example of the manufacture approach is given For example, after forming a low-temperature buffer layer and a GaN lower growth phase on the silicon on sapphire which makes a substrate principal plane C side, Growth inhibition film, such as silicon oxide, is formed in the whole surface, and size (several microns thru/or dozens of microns) of opening is formed in the growth inhibition film, and it forms so that the crystal section of an abbreviation hexagon-head drill configuration may be made to project from this opening with the selective growth using the opening. At this time, it grows up as a facet toward which the Sth page ([1-101] side) or [11-22] side inclined, for example as an inclined plane (facet) of the crystal section of an abbreviation hexagon-head drill configuration. A luminescence field can be formed in the inclined plane of the crystal section of an abbreviation hexagon-head drill configuration by forming a barrier layer in this Sth page etc. in the form inserted in the 1st conductivity-type semi-conductor layer and the 2nd conductivity-type semi-conductor layer. A barrier layer is for example, an InGaN layer here, the lower 1st conductivity-type semi-conductor layer is formed from the GaN layer of for example, a silicon dopa, and the upper 1st conductivity-type semi-conductor layer is formed from the GaN layer of for example, a magnesium dope.

[0015] The bottom surface part of the light emitting diode 11 of an abbreviation hexagon-head drill configuration has the configuration of an approximate regular hexagon with this operation gestalt, although considering as the shape of a rectangle is also possible. for this reason, the thing for which the adjoining train arranges a light emitting diode 11 in the shape of [of half-pitch gap ******] a honeycomb — ** — the array of a dense component — possible — this ** — the brightness per unit area can be made the highest from a dense component array. each light emitting device — the maximum — as an example of the approach of making it arrange so that it may become dense, only the minimum margin distance each component is decided to be on a process is estranged and arranged. The minimum margin distance in this case is a distance decided by the precision of the alignment in an imprint process, the margin of the mask alignment in a photolithography process, etc., and there is an inclination which generally becomes short by improvement in a process technique. In addition, on these specifications, about the maximum dense array or the minimum margin, although it is desirable to consider as the distance as shortest margin on a process, it is the concept which had the width of face of a certain amount of fluctuation in the ideal shortest value, without being limited, and the distance near the minimum margin distance is also substantially included as a concept.

[0016] n lateral electrode and the p lateral electrode 13 are formed in the light emitting diode 11 of an abbreviation hexagon-head drill configuration. On the GaN layer of a magnesium dope, the p lateral electrode 13 vapor-deposits metallic materials, such as nickel/Pt/Au, or nickel(Pd) / Pt/Au, and is formed. The lower growth phase 14 which connects n lateral electrode to the GaN layer of a silicon dope functions as an n lateral electrode ejection field. The lower growth phase 14 is a semi-conductor layer used as a crystal kind at the time of selective growth, and since it is formed in the field larger than the base of an acumination part 12, it can aim at electric connection using the part which spread rather than the base of the acumination part 12. That is, in the lower growth phase 14, a part of wrap insulator layer 15 is removed in the front face, and the window part 16 for contact is formed. The wiring layer 17 is formed so that series connection may be carried out through a window

part 16. A wiring layer 17 connects the p lateral electrode 13 of the light emitting diode 11 which adjoins the lower growth phase 14 which is n lateral electrode ejection field through a window part 16. the light emitting diode 11 since the side in which this wiring layer 17 extends is a side to which the acumination part 12 is tapering off and only that part has only the space which takes about a wiring layer 17 in the perimeter of an acumination part 12 — ** — even when it is made to arrange densely, sufficient series connection can be planned. In addition, it is also possible to utilize the back tungsten film of selective growth as a part of takeoff connection of n lateral electrode in the case where the tungsten film is formed as growth inhibition film of selective growth.

[0017] Drawing 3 is the circuitry Fig. of the lighting system of this operation gestalt. Parallel connection of the train of two or more light emitting diodes 11 by which series connection is carried out is carried out, and it consists of constant current sources 18 for a drive. Let several of the predetermined n be a number corresponding to the value into which parallel connection of the configuration with which only the number of predetermined in light emitting diode 11 (the inside of drawing, n pieces) was connected to the serial was carried out, and it divided rated voltage by the forward voltage Vf of the light emitting diode 11 concerned. That is, it is made to carry out parallel connection of what carried out the about 30-piece series connection when the supply voltage to the lighting system concerned was [forward voltage Vf] 3.4V in 100V (bolt), and supply voltage should just be made to carry out parallel connection of that which carried out the about 60-piece series connection when forward voltage Vf was 3.4V by 200V (bolt).

[0018] Thus, even if it is the case where the forward voltage Vf of each light emitting diode 11 differs in carrying out series connection of two or more light emitting diodes 11 somewhat, the current value which flows n pieces by which series connection is carried out will be equalized. Therefore, it will concentrate on the light emitting diode 11 which has the low forward voltage Vf, a current will flow, and the problem that a life becomes short as the result, or a gap of brightness occurs will be prevented beforehand. Moreover, series connection of all is not carried out, but parallel connection of two or more light emitting diodes 11 is carried out for every number of predetermined individuals. For this reason, since the light emitting diode of other trains by which parallel connection is carried out emits light even when it changes into the condition that one light emitting diode 11 becomes poor temporarily, and a current cannot be passed, a lighting function will not necessarily be lost as a whole. Moreover, the light emitting diode 11 of the optimal number which can drive the number n of the light emitting diode 11 by which series connection is carried out to rated voltage by considering as the number corresponding to the value which broke rated voltage by the forward voltage Vf of the light emitting diode 11 concerned will drive, and efficient lighting is realized.

[0019] Here, if it explains referring to drawing 4 thru/or drawing 7 about the process of the light emitting device which has an acumination part, as a growth substrate 20 used in the case of manufacture of a light emitting device, especially if the compound semiconductor layer of a wurtzite mold can be formed, it will not be limited, but various things can be used. If it illustrates, that it can use as a base Sapphire (aluminum 2O3, the Ath page, the Rth page, and C side are included.) SiC (6H, 4H, and 3C are included.) It is the substrate which consists of GaN, Si, ZnS, ZnO, AlN, LiMgO, LiGaO2, GaAs, MgAl 2O4, InAlGaN, etc., is the hexagonal system substrate or cubic system substrate which consists of these ingredients preferably, and is a hexagonal system substrate more preferably. For example, in the case where silicon on sapphire is used, when growing up the ingredient of a gallium nitride (GaN) system compound semiconductor, the silicon on sapphire which made the principal plane C side used can be used. [many] C side as a substrate principal plane in this case includes field bearing to which it inclined 5 thru/or in 6 times. It is also possible to use the silicon substrate currently widely used for manufacture of a semiconductor device.

[0020] On the growth substrate 20 for carrying out selective growth, in order to acquire good crystallinity at the time of selection, a buffer layer etc. may be formed. Moreover, as shown in drawing 4 , on the growth substrate 20, the lower growth phase 21 of selective growth is formed. Since a compound semiconductor layer can be chosen and facet structure is formed at a next process as a lower growth phase 21, it is desirable to choose the compound semiconductor of a wurtzite mold. The nitride semi-conductor which furthermore has the crystal structure of a wurtzite mold as a compound semiconductor layer, a BeMgZnCdS system compound semiconductor, a BeMgZnCdO system compound semiconductor, etc. are desirable. As a crystal layer which consists of a nitride semi-conductor, an III group system compound semiconductor can be used, for example,

a gallium nitride (GaN) system compound semiconductor, an alumimium nitride (AlN) system compound semiconductor, an indium nitride (InN) system compound semiconductor, an indium nitride gallium (InGaN) system compound semiconductor, and an alumimium nitride gallium (AlGaN) system compound semiconductor can be formed further preferably, and especially a gallium nitride system compound semiconductor is desirable. As an example, on silicon on sapphire, the GaN layer of undoping may be formed and the GaN layer of Si dope may be formed after that. In addition, in this invention, even if InGaN, AlGaN, GaN, etc. contain aluminum of the minute amount in the range to which only mixed crystal does not point out the nitride semi-conductor [of 2 yuan] of only mixed crystal of 3 yuan, for example, an operation of InGaN is not not necessarily changed by InGaN, and other impurities, it cannot be overemphasized that it is the range of this invention. Moreover, an equivalent field includes substantially field bearing to which it inclined 5 thru/or in 6 times to the Sth page in the Sth page. this detail in the letter and a nitride may make B, aluminum, Ga, In, and Ta an III group, and may point out the compound which contains N in V group here, and 1x1020cm mixing of less than 1% of the whole and 3 or less impurity may be included

[0021] As the growth approach of this lower growth phase 21, various vapor growth can be mentioned, for example, vapor growth, such as organometallic compound vapor growth (MOCVD (MOVPE) law) and a molecular beam epitaxy method (MBE law), and hydride vapor growth (HVPE law) can be used. According to the MOVPE method, a crystalline good thing is quickly obtained also in it. As the Ga source, as TMG (trimethylgallium), TEG (triethylgallium), and the aluminum source, many alkyl metallic compounds, such as TMI (trimethylindium) and TEI (triethylindium), are used, and gas, such as ammonia and a hydrazine, is used as a nitrogen source as TMA (trimethylaluminum), TEA (triethylaluminum), and the In source by the MOVPE method. moreover — if it is Si as the impurity source, it is silane gas and germanium and it is germane gas and Mg — Cp2 — if it is Mg (magnesium cyclopentadienyl) and Zn, gas, such as DEZ (diethyl zinc), will be used. By the MOVPE method, epitaxial growth of the InAlGaN system compound semiconductor can be carried out by supplying these gas to the front face of the substrate heated for example, more than 600-degreeC, and decomposing gas.

[0022] The selection mask 22 which has the opening 23 which carried out opening to the hexagon is formed in the front face of the lower growth phase 21 of crystal growth, and as shown in drawing 5 , the semi-conductor layer 24 is formed of the selective growth from the opening 23 which carried out opening to the shape of the hexagon. The mask ingredient which the selection mask 22 is growth inhibition film formed on the layer of the buffer layer formed on direct or a base on the base principal plane and others, for example, consists of insulator layers, such as silicon oxide film and a silicon nitride film, is used. Although the configuration of this mask is made into the shape of a hexagon as an example, they may be polygon configurations, such as the shape of the shape of band-like, a circle configuration, circular, or a triangle, and a pentagon. Moreover, in the case where the tungsten film is formed as growth inhibition film of selective growth, it also becomes possible to utilize the back tungsten film of selective growth as a part of takeoff connection of n lateral electrode.

[0023] In the place in which the mask 22 grade of such selective growth was formed, the semi-conductor layer 24 is formed with alternative crystal growth. Crystal growth can be performed by the same approach as the approach for formation of the above-mentioned compound semiconductor layer. As the growth approach, various vapor growth can be mentioned, for example, specifically, vapor growth, such as organometallic compound vapor growth (MOCVD (MOVPE) law) and a molecular beam epitaxy method (MBE law), and hydride vapor growth (HVPE law) can be used.

[0024] In the manufacture approach of the light emitting device concerned, as for the crystal face where the semi-conductor layer 24 inclined although the semi-conductor layer 24 was formed of selective growth, it is desirable that it is the desirable field substantially chosen from equivalent fields to {1-101} side, {11-22} sides, or each of these fields, and it is the crystal face which appears by carrying out selective growth on condition that necessary. The growth phase surrounded by the crystal face which these-inclined is made into the shape of a pyramid of a hexagon-head drill configuration, and is the cusp configuration of a cross-section abbreviation trigonum. As this sloping crystal face, an equivalent field can be substantially formed in an equivalent field, {11-22} side, or {11-22} side easily by making the principal plane of a substrate into C+ side, for example at the Sth page or the Sth page. That is, in the case where selective growth is performed, as an inclined plane which inclined to the substrate principal plane, the Sth page and {11-22} side are stable fields seen when

selective growth is carried out on C+ side, and are a field which is comparatively easy to acquire. As C+ side and C-side exist in C side, although S+ side and S-side exist about the Sth page, when not refusing especially in this specification, S+ side is grown up on the C+ side GaN, and this is explained as Sth page. In addition, about the Sth page, S+ side is a stable field. Moreover, the indices of crystal plane of C+ side are (0001).

[0025] When [this] the Sth page is attached and a crystal layer is constituted using a gallium nitride system compound semiconductor, the Bond number from Ga to N increases in the degree of 2 or 3, and C-side on the Sth page. Since C-side cannot be acquired as a matter of fact on C+ side here, the Bond number in the Sth page will become [most]. For example, although the front face of the nitride of a wurtzite mold generally turns into C+ side when a nitride is grown up to be silicon on sapphire which has C+ side in a principal plane By using selective growth, it will be stabilized, the Sth page can be formed, and it will join together in at least one or more pounds at the Sth page to which the bond with the inclination from which it is easy to be desorbed in respect of being parallel to C+ side of N inclined from Ga to having joined together with one bond. Therefore, it is V/III effectually. A ratio will go up and it is advantageous to the crystalline improvement in a laminated structure. Moreover, if it grows up to be different bearing from a substrate, since the rearrangement extended upwards from the substrate will bend, it becomes advantageous also to reduction of a defect.

[0026] As shown in drawing 6 , the laminating of the 1st conductivity-type cladding layer 25, the 1st barrier layer 26, and the 2nd conductivity-type cladding layer 27 is carried out to such a semi-conductor layer 24 on an inclined plane. If the facet structure this invention persons grew up to be in the experiment which followed the nitride semi-conductor using cathode luminescence is observed, the crystal of the Sth page which is an inclined plane is good, and it is shown that luminous efficiency is high as compared with C+ side. Especially growth temperature of an InGaN barrier layer is set for example, to 700-800-degreeC. At this temperature, the decomposition effectiveness of ammonia is low and N kind is needed more. Moreover, when the front face was seen by AFM, the field where steps were together suitable for InGaN incorporation was observed. Although the growth front face of Mg dope layer moreover has a still worse surface state in AFM level generally, it turns out that it grows up by the surface state also with this sufficient Mg dope layer with growth of the Sth page, and doping conditions moreover differ considerably. Moreover, it is C+, although it can measure with the resolution of about 0.5 - 1 micrometer if micro photoluminescence mapping is performed. By the usual method of having grown up on the field, the unevenness of 1-micrometer pitch extent existed and the uniform result was obtained about the sample which obtained the Sth page with selective growth. Moreover, the surface smoothness of the slant face seen by SEM is also C+. It changes more smoothly than a field.

[0027] In the 1st conductivity-type cladding layer 25 by which a laminating is carried out on an inclined plane, the 1st barrier layer 26, and the 2nd conductivity-type cladding layer 27, the 1st conductivity type is p mold or an n mold, and the 2nd conductivity type is the opposite conductivity type. For example, in the case where the gallium nitride system compound semiconductor layer of a silicon dope constitutes the crystal layer which constitutes the Sth page, the gallium nitride system compound semiconductor layer of a silicon dope constitutes n mold cladding layer 25, an InGaN layer is formed as a barrier layer 26 on it, further, on it, the gallium nitride system compound semiconductor layer of a magnesium dope can be formed as a p mold cladding layer 27, and double hetero structure can be formed.

[0028] In addition, it is also possible to consider as the structure which is the 1st barrier layer 26 and whose InGaN layer is pinched in an AlGaN layer, for example, or the structure which forms an AlGaN layer only in one side. Moreover, the 1st barrier layer 26 may form quantum well structures, such as single quantum well (SQW) structure, duplex quantum well (DQW) structure, and multiplex quantum well (MQW) structure, although constituting from a single bulk barrier layer is also possible. A barrier layer is used together by quantum well structure if needed for separation of a quantum well. Especially when a barrier layer 26 is used as an InGaN layer, it becomes the structure which a production process top also tends to manufacture, and the luminescence property of a component can be improved. That it is easy to crystallize, moreover, crystallinity also becomes good and, furthermore, this InGaN layer can raise luminous efficiency especially by the growth on the Sth page which is the structures from which a nitrogen atom cannot be desorbed easily. In addition, although a nitride semi-conductor has the property in which a non dope also serves as n mold for the nitrogen

hole made during a crystal, donor impurities, such as Si, germanium, and Se, can usually be used as n mold with desirable carrier concentration with doping in crystal growth. moreover, in order to use a nitride semi-conductor as p mold, it be obtain by dope acceptor impurity, such as Mg, Zn, C, Be, calcium, and Ba, during a crystal, but in order to obtain p layers of high carrier concentration, after the dope of acceptor impurity, it be desirable to perform annealing above 400 degrees C in inert gas ambient atmospheres, such as nitrogen and an argon, the approach activate by electron beam irradiation etc. also have it, and the approach activate by a microwave exposure, optical exposure, etc. also have it.

[0029] An electrode is connected to the 1st conductivity-type cladding layer 25 and the 2nd conductivity-type cladding layer 27 which sandwich the 1st barrier layer 26 directly or indirectly. Although each electrode is formed for every component, it can also communalize either p electrode or n electrode with two or more components. In order to lower contact resistance, a necessary contact layer may be formed and an electrode may be formed on a contact layer after that. Generally, although each electrode puts a multilayer metal membrane by vacuum evaporationo etc. and is formed, in order to classify for every component, it can use photolithography and it can carry out micro processing by lift off etc. Each electrode can also be formed in one field of a selection crystal growth layer or a substrate, forms an electrode in both sides, is more high-density and can wire an electrode. Moreover, although micro processing of the electrode driven independently may be carried out, respectively and it may form the same ingredient, it is also possible to use the electrode material of a different ingredient for every field. Moreover, since it connects with the lower semi-conductor layer 21 electrically, the 1st conductivity-type cladding layer 25 may form n lateral electrode in the form connected to this lower semi-conductor layer 21. Since especially the lower semi-conductor layer 21 is used also as a lamination side, it can arrange an electrode in an adhesion side, or gives conductivity to a glue line, and can use it as some n lateral electrodes.

[0030] Moreover, by the semi-conductor light emitting device of this invention, it can also consider as the structure which forms an electrode only in the good part of the crystal structure alternatively especially. For example, when there is a field in which the step of a crystal is not equal to the crystal face, the field top which has not had complete set of of the step can be removed, and an electrode can be formed. Existence of the field which has not had complete set of step of such a crystal can be grasped by the observation which used AFM, a rule of thumb, etc., and can form the electrode of the structure which removed the part on a ridgeline, the field near an edge, etc. as an example.

[0031] Next, as shown in drawing 7 , exfoliation of the growth substrate 20 is performed. Although it is also possible to remove the growth substrate 20 by etching, polish, etc., by the case where the growth substrate 20 is made into transparent silicon on sapphire, laser ablation occurs between the growth substrate 20 and the lower semi-conductor layer 21 on it by irradiating the beam of the laser of the ultraviolet-rays region from the rear face of the growth substrate 20, for example, an excimer laser, and an YAG lasor. This laser ablation is the technique of irradiating the beam of the range of ultraviolet rays, generating the nitrogen of the GaN(s) which are the ingredients of the lower semi-conductor layer 21 from the light absorption energy of a beam in the interface between the growth substrate 20 and the lower semi-conductor layer 21, and separating the growth substrate 20 and the lower semi-conductor layer 21. In the case where the growth substrate 20 is made into silicon on sapphire, silicon on sapphire can be penetrated, beams, such as an excimer laser, can be irradiated, and the growth substrate 20 and the lower semi-conductor layer 21 can be separated easily. According to separation of the growth substrate 20, a light emitting device serves as structure for every component, as shown in drawing 8 , and the base 28 of the lower semi-conductor layer 21 exposes it.

[0032] After separation of the growth substrate 20, as the light emitting device 30 separated separately shows drawing 9 , it is stuck on the support substrate 29. For example, an imprint technique can perform this lamination, and, as for each light emitting device 30, the pars basilaris ossis occipitalis of the lower semi-conductor layer 21 is stuck on the front face of the support substrate 29. Then, the oxide film used as formation and the interlayer insulation film of p lateral electrode which consists of a metal thin film is formed, a window part is formed in some oxide films on the lower semi-conductor layer 21, a contact hole is formed, and series connection is performed by connecting using a necessary wiring layer between the components which adjoin the lower semi-conductor layer 21 faced at the pars basilaris ossis occipitalis of the contact hole in p lateral

electrode. That is, the series connection of light emitting diode is formed by repeating connecting with the lower semi-conductor layer 21 of one component electrically p lateral electrode of the component which adjoins this, and performing it.

[0033] Next, the operation gestalt of other lighting systems of this invention is explained, referring to drawing 10 and drawing 11 . The lighting system of this operation gestalt is an example in which the cusp-like light emitting diode 41 is arranged in the shape of a matrix, and the resistance section 43 is connected to each light emitting diode 41 at a serial.

[0034] Light emitting diode 41 has the acumination part 48 of the tapering configuration of an abbreviation hexagon-head drill configuration, and the hexagon-head plate-like lower growth phase 49 is formed in the pars basilaris ossis occipitalis. The light emitting diode 41 which has the crystal section of such an abbreviation hexagon-head drill configuration If the compound semiconductor layer of a GaN system can constitute like the above-mentioned light emitting diode 11 and an example of the manufacture approach is given For example, after forming a low-temperature buffer layer and the lower growth phase 49 on the silicon on sapphire which makes a substrate principal plane C side, Growth inhibition film, such as silicon oxide, is formed in the whole surface, and size (several microns thru/or dozens of microns) of opening is formed in the growth inhibition film, and it forms so that the crystal section of an abbreviation hexagon-head drill configuration may be made to project from this opening with the selective growth using the opening. At this time, it grows up as a facet toward which the Sth page ({1-101} side) or {11-22} side inclined, for example as an inclined plane (facet) of the crystal section of an abbreviation hexagon-head drill configuration. A luminescence field can be formed in the inclined plane of the crystal section of an abbreviation hexagon-head drill configuration by forming a barrier layer in this Sth page etc. in the form inserted in the 1st conductivity-type semi-conductor layer and the 2nd conductivity-type semi-conductor layer. A barrier layer is for example, an InGaN layer here, the lower 1st conductivity-type semi-conductor layer is formed from the GaN layer of for example, a silicon dope, and the upper 1st conductivity-type semi-conductor layer is formed from the GaN layer of for example, a magnesium dope. The bottom surface part of the light emitting diode 41 of an abbreviation hexagon-head drill configuration has the configuration of an approximate regular hexagon with this operation gestalt, although considering as the shape of a rectangle is also possible. In addition, although it considers as the structure where light emitting diode 41 is stuck on the support substrate 44 where the lower growth phase 49 is formed, with this operation gestalt, this operation gestalt may have the structure stuck on a support substrate in the condition that there is no lower growth phase 49.

[0035] As shown in drawing 10 R> 0, the spiral-like resistance section 43 is connected to such light emitting diode 41. The spiral-like resistance section 43 is high resistance wiring extended by turning around light emitting diode 41, for example, is formed of the layer which introduced a metal thin film, the polycrystal semi-conductor layer of low high impurity concentration, carbon black, etc. The spiral-like resistance section 43 functions as resistance from the configuration, and connects the end by the side of the core of the spiral-like resistance section 43 to the lower growth phase 49 by the side of the pars basilaris ossis occipitalis of light emitting diode 41. Although the perimeter of light emitting diode 41 is gone around about a little more than 2 rounds and it connects with a grounding conductor 42 with this operation gestalt, the thing of illustration may not pass over a configuration, a pattern, etc. of the resistance section 43 to an example, but other patterns etc. may be used for the resistance section 43. Moreover, in this operation gestalt, a grounding conductor may be communalized in the adjoining train. In addition, the resistance section can also be formed in the p side of light emitting diode although the side which forms the resistance section is made into the n side with this operation gestalt.

[0036] The p lateral electrode 45 of light emitting diode 41 is formed in the acumination part of light emitting diode 41, respectively, as shown in drawing 11 , p lateral electrodes 45 each contact the common electrode 46 formed in the base side of the opposite substrate 47 in the top-most-vertices section, and the flow is achieved.

[0037] Drawing 12 is the circuitry Fig. of the lighting system of this operation gestalt. It is constituted by the constant current source 50 so that the group of light emitting diode 41 and the resistance section 43 may connect with juxtaposition. A problem on which series connection of the resistance will be carried out to light emitting diode 41, a circuit will consist of this circuitry, for example, the current which flowed that light emitting diode 41 that got worse even if it was a case so that one

light emitting diode 41 may become poor and may short-circuit will flow, concentrates the resistance section 43 certainly on one of the light emitting diodes by which parallel connection was carried out, and a current flows is prevented beforehand. Moreover, since resistance goes into each light emitting diode at a serial even when the forward voltage Vf of light emitting diode 41 varies, a problem on which it concentrates on a component with low forward voltage, and a current flows will also be controlled.

[0038] Drawing 13 is the typical side elevation showing an example of the lighting system of further others. The maximum dense array of the light emitting diode 61 is carried out at the front-face side of the support substrate 62 of light transmission nature, and while the fluorescent substance layer 63 is formed in the base side of the support substrate 62, a protective coat 64 is formed so that the fluorescent substance layer 63 may be covered. Light emitting diode 61 is the cusp-like like the above-mentioned light emitting diodes 11 and 41. In this lighting system, the brightness per unit area can be made the highest, securing good wiring from the maximum dense array of two or more light emitting diodes 61 being carried out at the front-face side. The light injected from light emitting diode 61 penetrates the support substrate 62 of light transmission nature, and reaches the fluorescent substance layer 63. In this fluorescent substance layer 63, it is excited by the light from light emitting diode 61, and light is again emitted from the fluorescent substance layer 63. The light emitted from the fluorescent substance layer 63 at this time can take out the light of the wavelength of arbitration, without being caught by coloring of light emitting diode because it is changed and outputted and predetermined chooses the wavelength of the light which light emitting diode 61 emits as a fluorescent substance priest 63.

[0039] The fluorescence layer which uses the light emitting diode of blue luminescence as a light emitting device, is excited by blue glow as an optical-pumping fluorescent substance layer as an example of the lighting system using such a fluorescent substance layer, and enables yellow luminescence can be formed. Moreover, the fluorescence layer which can also use the light emitting diode of purple luminescence, is excited with purple light as said optical-pumping fluorescent substance layer as a light emitting device, and enables white luminescence can be formed. White luminescence can be made by mixing red and a blue and green fluorescent substance, and constituting, mixing the fluorescent substance of blue and yellow, or mixing the fluorescent substance of red and a cyanogen color.

[0040] Drawing 14 is the mimetic diagram of projection equipment. the projection equipment of this operation gestalt — the light emitting diode of the shape of cusp like the above-mentioned — two or more — ** — it consists of a lighting system 71 made to arrange densely and a liquid crystal display 72 of the transparency mold arranged in the optical ejection side. A lighting system 71 can secure good wiring from each light emitting diode being the cusp-like, and can make the brightness per unit area the highest. A liquid crystal display 72 is the transparency mold image display section arranged in the optical projection way of a lighting system, and controls the light which penetrates by performing the display which received the necessary picture signal and reflected this picture signal. According to this projection equipment, the high projection image of brightness can be displayed using the directive height of light emitting diode. Moreover, since the angle of beam spread is narrow, the louver etc. is unnecessary, and since a field emits light, it excels also in portability. Moreover, since a color separation die clo MIKKU filter is also unnecessary, the further miniaturization is also realizable.

[0041] In addition, in an above-mentioned operation gestalt, although light emitting diode was mainly explained as a light emitting device, a light emitting device may be semiconductor laser. Moreover, although the thing of a 6 pyramid configuration was mainly illustrated about the configuration of light emitting diode in the above-mentioned operation gestalt, other configurations, for example, a cross section, may be configurations of the shape of a trigonum or a stripe of trapezoidal shape, and it is also possible to put the light emitting diode of these complex patterns in order. Moreover, although size of the light emitting diode arranged is made into abbreviation identitas with this operation gestalt, it is also possible to be able to combine the light emitting device of different size, height, and a configuration, and to constitute a lighting system combining light emitting diode and semiconductor laser on the same support substrate.

[0042]

[Effect of the Invention] As mentioned above, according to the lighting system of this invention, by

carrying out the maximum dense array of the luminescence side which is the light-emitting part arranged in the shape of a field, the brightness per unit area can be made the highest and the connection to the electrode of the both sides by the side of n and p can be prepared in the side in which it exists for an acumination part [a component] by moreover using a cusp-like light emitting device. the side attachment wall over luminescence sides, such as a rectangular parallelepiped and tabular, — a luminescence side — receiving — abbreviation — when using a cusp-like light emitting device compared with the component structure which becomes perpendicular, wiring while using the tooth space as for which the perimeter for an acumination part was vacant is attained, and sufficient connection can be aimed at even if it carries out the maximum dense array.
[0043] Moreover, with the projection equipment of this invention, since light emitting diode is used, the high projection image of brightness can be displayed. Moreover, compared with what makes a lamp etc. the light source, it excels in portability. Since the angle of beam spread is still narrower, a louver is unnecessary and a color separation die clo MIKKU filter etc. has it. [still more unnecessary] For this reason, the further miniaturization can be attained.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

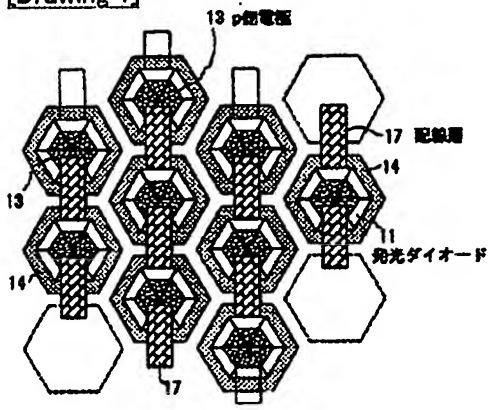
[Brief Description of the Drawings]
[Drawing 1] It is the top view of the important section of 1 operation gestalt of the lighting system of this invention.
[Drawing 2] It is the sectional side elevation of the important section of 1 operation gestalt of the lighting system of this invention.
[Drawing 3] It is the circuit diagram of 1 operation gestalt of the lighting system of this invention.
[Drawing 4] It is a process sectional view for explaining the manufacture approach of the light emitting diode used for 1 operation gestalt of the lighting system of this invention in order of a process, and is a process sectional view to the process in which the lower growth phase was formed.
[Drawing 5] It is a process sectional view for explaining the manufacture approach of the light emitting diode used for 1 operation gestalt of the lighting system of this invention in order of a process, and is a process sectional view to a selective growth process.
[Drawing 6] It is a process sectional view for explaining the manufacture approach of the light emitting diode used for 1 operation gestalt of the lighting system of this invention in order of a process, and is a process sectional view to a clad stratification process.
[Drawing 7] It is a process sectional view for explaining the manufacture approach of the light emitting diode used for 1 operation gestalt of the lighting system of this invention in order of a process, and is a process sectional view to a laser ablation process.
[Drawing 8] It is drawing showing the structure of the light emitting diode obtained by the laser ablation of drawing 7 , and (a) is the sectional view of light emitting diode, and (b) is the top view of light emitting diode.
[Drawing 9] It is a process sectional view for explaining the manufacture approach of 1 operation gestalt of the lighting system of this invention, and they are lamination and a process sectional view at the time about light emitting diode.
[Drawing 10] It is the top view of the important section of other 1 operation gestalten of the lighting

system of this invention.
[Drawing 11] It is the sectional side elevation of the important section of other 1 operation gestalten of the lighting system of this invention.
[Drawing 12] It is the circuit diagram of other 1 operation gestalten of the lighting system of this invention.
[Drawing 13] It is the sectional side elevation of the important section of 1 operation gestalt of further others of the lighting system of this invention.
[Drawing 14] It is the mimetic diagram of 1 operation gestalt of the projection equipment of this invention.
[Description of Notations]
11 Light Emitting Diode
12 Acumination Part
13 P Lateral Electrode
14 Lower Growth Phase
15 Insulator Layer
16 Window Part
17 Wiring Layer
20 Growth Substrate
21 Lower Growth Phase
22 Selection Mask
23 Opening
24 Semi-conductor Layer
25 Cladding Layer
26 Barrier Layer
27 Cladding Layer
29 Support Substrate
30 Light Emitting Diode
41 Light Emitting Diode
43 Resistance Section
44 Support Substrate
45 P Lateral Electrode
46 Common Electrode
47 Opposite Substrate
50 Constant Current Source
61 Light Emitting Diode
62 Support Substrate
63 Fluorescent Substance Layer
64 Protective Coat
71 Lighting System
72 Liquid Crystal Display

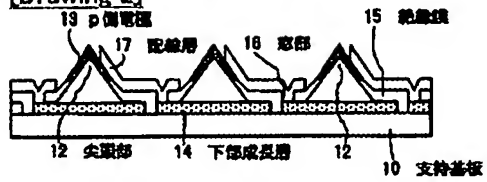
[Translation done.]

DRAWINGS

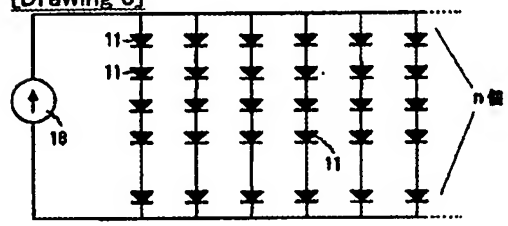
[Drawing 1]



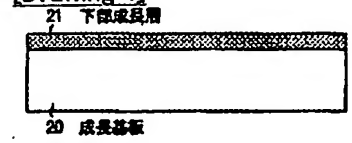
[Drawing 2]



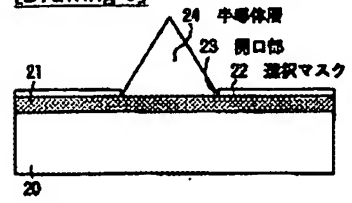
[Drawing 3]



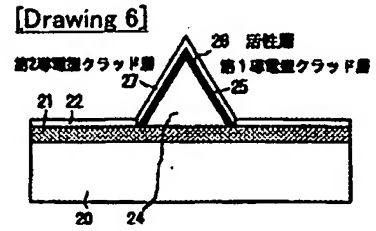
[Drawing 4]



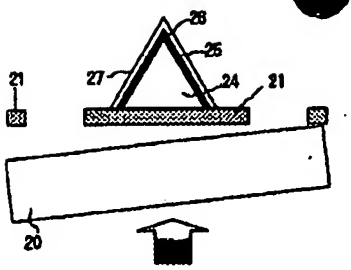
[Drawing 5]



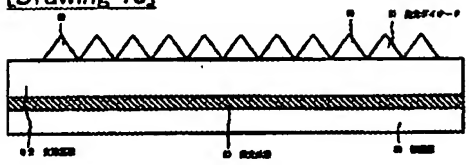
[Drawing 6]



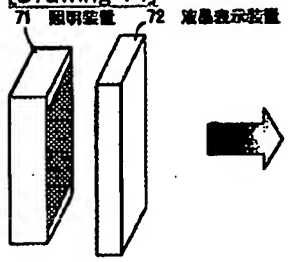
[Drawing 7]



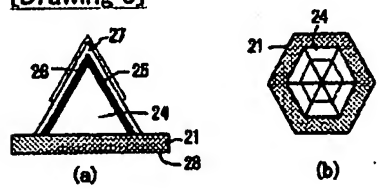
[Drawing 13]



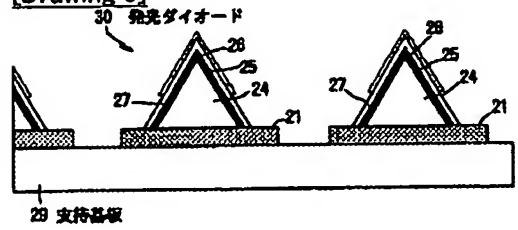
[Drawing 14]



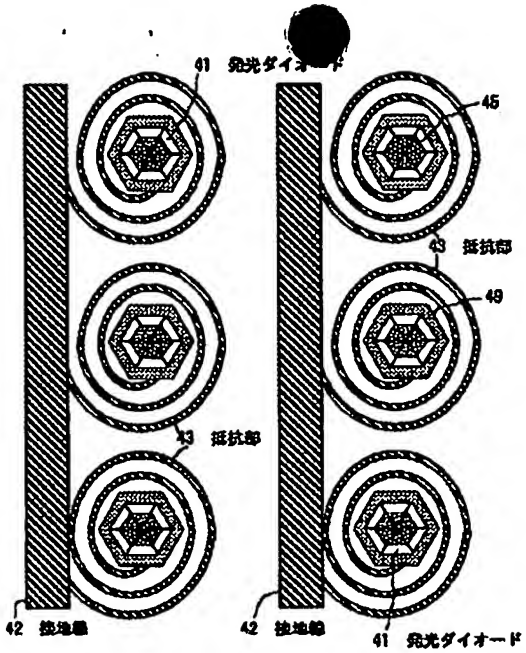
[Drawing 8]



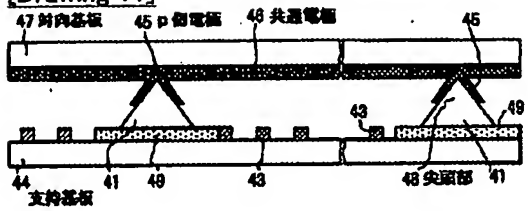
[Drawing 9]



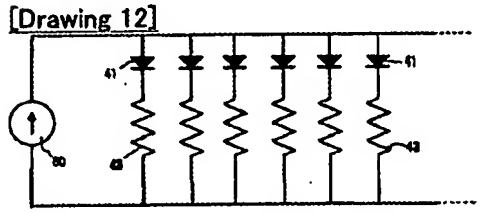
[Drawing 10]



[Drawing 11]



[Drawing 12]



<EMI ID=000014 HE=026 WI=067 LX=0240 LY=1980>

[Translation done.]